

Integration of AI Technology into Vocal Music Education: An Investigation of Teachers' Attitudes in Higher Education in Guangdong, China

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Abstract: The introduction of technologies based on artificial intelligence (AI) is changing the process of pedagogical teaching of music in particular, in the context of the higher education environment that is in the process of digitalization. The examples of AI-aided tools in the sphere of vocal music education are intelligent accompaniment, automated pitch analysis, and an adaptive learning platform, which allow offering new opportunities in individualized instructions, real-time feedback, and performance-based learning. However, there is limited empirical investigation of the views of teachers on the implementation of the AI-enhanced technology and the perceived advantages, obstacles, and professional developmental needs of the technology use. In this paper, the attention will be directed to the perceptions of teachers regarding the adoption of the AI-enhanced technology in the teaching of vocal music within the higher education in Guangdong. The quantitative cross-section survey design was chosen, and 223 vocal music educators in the institutions of higher learning participated. The questionnaire evaluated the attitude of the teachers to AI-enhanced technologies, their perception of the instructional benefits, their perception of the barriers, and their experience of professional development. The results indicate mediocre positive attitudes and considerable barriers in terms of time constraint, institutional support, and availability of special training. Perceived benefits correlated significantly with attitudes of teachers, and professional development was not an independent predictor of attitude. Overall, the findings reveal that pedagogical value is one of the determinants of accepting AI-enhanced technologies by teachers and offers hints on how institutional support and pedagogically oriented professional development should be.

Keywords: Artificial intelligence; vocal music education; technology integration; teacher attitudes; higher education

1. Introduction

The integration of technology in the learning process has literally changed the teaching and learning process in other subjects of study, and music education is not an exception. The past two decades also presented new tools and resources to teachers who involve students, make them creative, and enhance their performance with the help of educational technologies^{[1][2][3]}. The digital technologies have made more of the music content and learning opportunities accessible that would have been difficult to reach through the traditional mechanisms of teaching. However, the instruction of music in elementary and secondary schools has been long-standing and traditionally-oriented on the classical traditions, which are aimed at learning the theoretical material and technical skills associated with the traditional musical language and practice of musical instruments^{[4][5]}. Similarly, technology has been used to augment the already established teaching techniques rather than altering the very essence of the teaching process, despite the fact that it has enabled more specialized activities that relate to research on music, composition, classification, and alteration of sounds^[6]. Practices of music that are technologically based have been empirically demonstrated to be pedagogical. Provision Indicatively, a longitudinal examination of sound-based music in De Montfort University showed that it could offer technological support in facilitating new musical exploration and composition in the education sector^[7]. The same concept has been suggested by previous research stating that music software can lessen the obstacles to composition and other creative barriers, particularly in young learners^[8]. Nevertheless, it is on the same literature that the majority of studies have focused more on competencies and learning outcomes of students and ignored the technological competence, pedagogical preparedness, and professional

competence that teachers must have. It has been unveiled that pre-service and in-service teachers do not have the time, resources, and institutional assistance to engage productively with the emerging technologies and studies on the same ^[9]. Moreover, the development of pedagogical content knowledge during the technology-enhanced instruction assumes the technical expertise and modification of beliefs and teaching activities among teachers that requires the long-term theoretical foundation and professional development ^[10].

Technology addition to the music education process is, however, superficial, although the alternative of high-quality digital resources teaching and learning music is becoming more and more popular over the years (e.g. the Sound Exchange platform developed by the Philharmonia Orchestra that facilitates interactive interfaces, sample libraries, forums, live webcasts, and instructional videos ^[11]). In technologically developed environments, like in Australia, the music teaching usually takes a traditional, informational, and information-based approach to teaching rather than an interactional, creative, and student-oriented approach ^[11]. The existing literature suggests that even the use of technology in music education by teachers can largely be characterized by low levels of adoption and no or minimal change in pedagogy, and that can be interpreted to mean that the availability of technology is not sufficient to achieve a significant change in instruction ^[11]. Most recently, the emergence of technologies based on artificial intelligence (AI) has established a new tier of educational technologies integration qualitatively. Unlike older forms of digital technologies, the AI-mediated systems may be employed to provide intelligent feedback, adaptive learning paths, and data-based instructional support, and, therefore, disrupt the established teacher-centered modalities of instruction. Their advancements are of particular significance in music education, particularly in vocal music education. The feature of the customized response, embodied technique, physiological consciousness, and continuous control of the performance are critical parts of vocal training, and they suit well the affordances in AI-enhanced tools, such as automated pitch detectors, intelligent accompaniment instruments, and adaptive vocal training programs. These technologies stand a high chance of ensuring that learning is not only studio-based but also that learning is tailored, and also through these technologies, the teacher-student interaction in the vocal pedagogical context is re-defined.

The feelings of teachers towards technology are highly conclusive in deciding on the mode of introduction and introduction of such innovations in the teaching practice. The cultural context also influences the technology acceptance since it influences the belief about the innovation, usefulness and professional norms. The cross-cultural studies evidence has shown that the influence of subjective norms is stronger in the culture that the aspect of collectivism is dominant such as the Chinese where individuals consider more of the common expectations and formal direction ^[12]. Studies on Chinese teachers have found out that the perceived ease of use may not be so significant as perceived instructional value because the teachers will emphasize on teaching effectiveness and efficiency and not technical convenience ^[13]. Quite the contrary, a teaching environment, such as the United States, that cherishes individualism and inventiveness is more likely to present technology in the form of enhancing creativity, autonomy and student agency, which, actually, do not necessarily lead to such aspects becoming firmly embedded within the classroom practice ^[14]. Although a growing amount of literature has been published on the study of the technology integration in education, there has been little empirical research on the study topic of teacher attitudes in relation to the AI-enhanced technology integration in vocal music education. The latter is particularly noticeable in the framework of higher education, with institutional policies, professional growth frameworks, and high-speed initiatives of digital transformation interacting in complex manners. Being one of the pieces of Chinese higher education, this research proposal will help close this gap by focusing on how teachers perceive the use of AI-enhanced technologies in the teaching of vocal music, how they think this use benefits them, what they consider to be barriers, and their perceptions of professional development. By doing so, the research will contribute empirical information to the global discussions on the topic of AI-driven change in the field of music education and will also present the facts on how the perception of teachers mediates the implementation of AI-enhanced pedagogical practices in colleges.

2. AI-Enhanced Technology Integration in Music Education

Technology is actively introduced in everyday life and the educational process and provides the further evolution of the field of teaching and learning in all the domains, including music education ^[15] ^[16]. According to previous research, the need to improve the practical application and theoretical background of educational technologies has emerged to help create novelty in the classroom and digital revolution ^[17] ^[18]. Digital technologies in music education have expanded the pedagogical possibilities by offering creative work and teaching processes that are not limited to the traditional approach, including

the use of Digital Audio Workstations (DAWs), programs in the computer-based music notation, and on-line learning^{[19] [20] [21] [22]}. Along with the empirical evidence that shows the technologies assist students in their interaction with music by engaging in multitrack recording and sound manipulation and interactive composition activities, which also promote creativity, conceptual comprehension, and performance development^{[23] [24]}. These technologies were discovered to help to have meaningful learning in real-life conditions, enhance motivation and self-esteem and increase the level of student dedication to music learning^[24]. The available literature however views technology more as a user-driven teaching and learning tool and its effectiveness is influenced heavily both by the Pedagogical design by the teachers and the original ability of learners.

In more recent times, the emergence of technologies with artificial intelligence (AI) has brought a fundamentally new stage in the integration of technologies in the field of music education. Compared to digital tools used in the past, AI-enhanced systems may be automated, offer dynamic feedback, and utilize information in the delivery of instructional feedback, offering more responsive and personalized learning experiences. It has pedagogical implications in the domain of music education, and that is why AI-based applications are developed on the existing digital sources with new features of intelligent accompaniment, instant pitch and timbre recognition, and custom learning experiences. Therefore, AI-advanced technologies might potentially not only support the creative processes but also the manner of making instructional decisions and teacher-student interventions as well. Despite these affordances, it has continuously been shown that mere availability of the high-order technologies is not adequate in bringing about meaningful pedagogical change. The studies conducted in different learning institutions have also stated that the integration of technology in music education is often superficial, as there is often little use and change in the teaching strategies^[11]. These findings suggest that the adoption of AI-enhanced technologies is not only governed by the presence of technologies but also the disposition of the teachers, their professional agency, and the institutional context, which predetermines the process of teaching. Consequently, how, what, and how educators perceive, interpret, and apply AI-enhanced technologies to their teaching methods have become the key area of concern regarding the study of technology-as-a-source-of-transformation in the music education domain.

2.1. From Digital Tools to AI-Enhanced Systems in Music Education

The innovations of the latest ed tech contributed to the enlargement of the pedagogical possibilities of music teaching considerably, and the conventional approaches to teaching yield to the digitally mediated learning environments^{[15] [16]}. Past researchers have emphasized the use of digital technologies (e.g., Digital Audio Workstations (DAWs), music notation software, online learning platforms) in creative activities, which increase the level of engagement of students, as well as the development of the learning process outside the traditional classroom^{[19] [20] [21] [22]}. In particular, it was shown that multitrack recording and sound manipulation are possible with the assistance of DAWs and, therefore, facilitate composition, performance, and conceptual comprehension^{[23] [24]}. Despite the great degree of pedagogical utility these digital tools have, they are mostly user-mediated technologies that rely on the already available teacher and learner competencies, as well as teacher and learner teaching schemes. Even recent literature has become more categorical on the fact that AI-enhanced systems are a qualitative advancement of the earlier digital technology. On AI-assisted platforms, automated analysis, dynamic feedback, and individualized learning paths can be facilitated, and therefore, more responsive and data-driven instructional support can be provided. The specified change is particularly relevant to the sphere of music education, where AI-enhanced instruments complement the capabilities of the current platforms, such as GarageBand, Sibelius, and Soundtrap, and have new functionality, such as intelligent accompaniment, real-time performance analysis, and intelligent learning^{[25] [26]}.

Empirical literature reports that the implementation of digital and AI-proximate technologies in the educational process concerning music resulted in positive learning outcomes, including the improvement of motivation, the level of musical knowledge development, and the establishment of learner autonomy in various learning settings^{[27] [28] [29]}. However, the fact that the research on this matter has also identified the research issues that are persistent by nature, whereby access to technological resources may not always be helpful in learning or teaching change. The absence of adequate pedagogical internalization and theoretical foundation can lead to the students failing to make appropriate utilization of the technological affordances, and the teachers may tend to revert to their previous methods of instruction even in situations where they have the resources of high-level tools available^[11].

2.2. Teacher Attitudes and Professional Agency in AI-Enhanced Contexts

The views of the teachers on technology, their faith in having the skills to effectively utilize technology is directly linked to the success of integrating technology in teaching music. The previous studies have remained unanimous when it comes to exposing the fact that perceptions, beliefs, and self-efficacy of teachers are the most dominant variables that can influence the adoption of technological innovation in the teaching profession and the way it is adopted. In the area of music education, the confidence of teachers in terms of technological competence is higher; hence, they tend to employ the use of technology to attain the objectives of teaching students, such as learning about music theory, editing, and composition of sounds, thus enhancing engagement and conceptual learning^[20]. Conversely, this would create a problem in the delivery of instructions when teachers lacked confidence or a negative perception towards technology, and this is likely to limit the pedagogical prowess of digital and AI-enhanced solutions. Teacher self-efficacy is one of the psychological aspects that has been identified to influence the process of technology integration. Self-efficacy beliefs are also the determinants of the level of teacher commitment, effort, and persistence in instances where teachers feel challenged in the area of instruction concerning new technologies^[30]. Teachers with high self-efficacy are more willing to attribute instructional difficulties to insufficient effort or attempt at trying new things rather than insufficient ability, and the low ones are more willing to disengage and reject trying new tools^[30]. Interestingly, the research has laid greater emphasis on the fact that technological knowledge does not suffice in causing successful technology integration. Rather, the instructors must be in a position to incorporate the application of technology in the appropriate pedagogical frameworks, in order to align the digital tools to the learning goals and interests of the learners^[30].

The attitude of the teachers towards technology has also been clarified by empirical studies, particularly on the way in which institutional setting and availability of resources influence the attitude of the teachers towards the use of technology. In academic environments with many resources, the teacher is more likely to consider technology as a means of overcoming the limitations of traditional teaching of music, such as the restricted access to expensive musical instruments, and provide students with more viable learning opportunities^{[31][32]}. On the contrary, the absence of institutional backing can make teachers think of the introduction of technology as an addition to the number of loads, which will decrease their readiness to accept new practices. Although some research studies have demonstrated gender differences in technological literacy, generally cutting in their favor to higher levels of self-reported competence in male teachers, in general studies have not produced any significant gender difference in the real classroom integration practices, so there is probably a broader effect of pedagogical and contextual factors at play^{[30][33][34][35]}. Peer support networks and professional learning environments are also significant factors in shaping attitudes and practices of the teacher in the area of technology. The surveys carried out as part of the research revealed that educators frequently seek assistance from colleagues and provide them as the primary means of help in terms of the adoption of online and digital tools, and turn to online professional platforms and informal learning through social networks^[36]. The COVID-19 also made teachers more active in relation to online education, and they claimed improved technological acceptance and improved digital skills as the side effect of forced remote teaching^[36]. Nevertheless, this period also exhibited certain unsolved issues, including technical difficulties that prevented some teachers from delivering the instruction and disparate possibilities of producing digital learning resources, particularly among those who had more years of teaching experience^[36].

The first aspect of context that has been identified to have a critical influence when it comes to the attitude of teachers towards technology integration is that of institutional support. Research has found that there were many challenges in professional development among music teachers in Hong Kong, which were more prominent during online education, and this was mainly due to technological restrictions imposed by school policies and online infrastructure^[37]. Having the right priorities and the assistance of the institutions regarding integrating technology and possessing the correct priorities will help to ensure that the teachers are willing to assume a positive attitude and look into new ways of teaching. In its turn, low institutional commitment may cause teachers to feel overwhelmed with the weight of technical conditions, which impede the desire to innovate and reinforce the use of traditional instructional practices^{[38][39]}. Combined, the above studies suggest that the attitudinal tendencies of teachers towards the use of AI-assisted technology in the learning of music are a complex regression of personal belief, professional self-efficacy, peer support, and school conditions. These factors play a vital role in affecting professional agency of teachers that can be used to understand the variation in the degree of technological adoption in addition to identifying the circumstances that may lead to a significant pedagogical change in AI-enriched learning environments.

2.3. Cultural and Institutional Influences on AI-Enhanced Technology Adoption

Cultural and institutional background plays a crucial role in the perceptions about educational technologies, their adoption, and implementation into the instructional practice. The differences in the educational philosophy, the policy focus, and the professional standards reflect on the attitude of the teacher to innovation, the perceived utility of technology, and the willingness to introduce new tools in teaching and learning processes. The past research has determined that the factors are contextually salient around the concept of technology acceptance, wherein the cultural values play a role in shaping the subjective norms and expectations of the instructional change^[12]. A move towards creativity, autonomy, and student-centered learning has been identified in research undertaken in the Western educational environment, such as in the United States, and aligns with an overall positive attitude towards the use or adoption of educational technology^{[40] [41]}. Empirical evidence, though, does show that positive orientations are not always projected into deep or consistent classroom integration. Large-scale research surveys have shown that technology integration in the curriculum may remain insignificant as the teachers will consider technology as a possible disruptive element to an already existing teaching pattern rather than an instructional tool^[40]. These findings imply that the individualistic educational cultures would still be constrained to some pedagogical challenges that restrain meaningful utilization of technology.

Quite the contrary, the literature located within the Chinese educational context has underscored the influence of collectivist cultural beliefs, centralization of policy agenda, and institutional training systems on technology acceptance. Chinese teachers and students have been shown to focus more on the subjective norms and perceived teaching value in adopting the new technologies because of the importance of shared expectations and institutional instructions in attaching the attitudes towards innovation^{[12] [13]}. Although the traditional Chinese educational system is characterized by the standardization of teaching and assessment-based functions, recent studies have also indicated that the institutional investment in technology-based instruction has been increasing, particularly in tertiary and urban schools^[42]. Meanwhile, structural problems that include inequity in teacher capacity accessibility and professional development avenues in under-resourced or rural settings still exist^[43]. Researchers also examine the willingness of students and teachers to use the Internet-based and digital learning technologies and find that subjective norms, usefulness, and ease of use are important in determining the acceptance in different environments^[44]. To a certain degree, it is possible to support the idea that even in a Western educational environment, students of an East Asian origin are more likely to demonstrate technology acceptance, and it means that the correlation between cultural background and institutional factors is highly complex to define the attitudes towards technology^[45]. Nevertheless, rather than explaining such distinctions in relation to the opposition of national systems, recent studies suggest that it is important to pay attention to the role of exploring the relationship between cultural values and academic structure and the influence they have on the professional agency of an educator and the instructional decisions made.

Together with these findings, they suggest that adopting AI-enhanced technologies in music learning can not be described as a phenomenon that can be attributed solely with terms of individual attitudes or technological affordances in education. Instead, the technological integration is embedded in bigger cultures and institutional settings that formulate professional standards and training prospects and anticipation of pedagogical transformation. The awareness of these contextual factors will play a significant role in comprehending the attitude of teachers towards AI-enhanced technology and what circumstances give a meaningful and long-lasting change to music teaching in higher education institutions.

2.4. Hypotheses

The hypotheses that will be proposed in this study, in view of the literature above, include:

H1: The perceived benefits of AI-enhanced technologies could be positively connected to the attitude of teachers to AI-enhanced technology application in the realm of vocal music education.

H2: Teacher attitudes are negatively related to perceived barriers to the integration of the AI-enhanced technology.

H3: There is a positive association between attitudes to integration related to professional development experience with AI-enhanced technologies and teacher attitudes towards integration.

3. Methodology

This study examined the perception of the teachers, the perceived benefits, perceived challenges, and experience related to the use of the AI-enhanced technology integration in teaching vocal music in higher education in Guangdong. The survey design was a cross-sectional survey design, which was also quantitative in nature. The number of responses was 225. Two student responses were omitted, and the rest of the responses were valid teacher questionnaires that were further reduced to 223. The cross-sectional design helps analyze the relationships between the main variables at a single moment and is appropriate to carry out the research to explore the connection between the perception of the teachers and AI-related approaches to instruction [46].

3.1. Data Collection Instrument

The method of data collection was the structured questionnaire, which is premised on the existing literature and adjusted to incorporate the new reality of AI-enhanced technologies in the sphere of vocal music education. The tool measured four AI integration dimensions, perceived benefits, perceived barriers, and experience of professional development. Rating of items was done in a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). One item that was negatively phrased was inverted and analyzed. The composite mean scores were assigned to every construct. Internal consistency reliability was tested with the help of Cronbach's alpha [47]. The survey was online and lasted for two months, based on academic networks and professional sites that targeted the higher education vocal music educators in Guangdong.

3.2. Data Analysis

Descriptive and inferential statistical tests were used to test the proposed hypotheses. The descriptive statistics helped to summarize the demographic information and the overall scores of the main constructs of the participants. To determine the relationship between the perceived benefits, perceived barriers, experience of professional development, and attitudes of teachers with AI-enhanced technology integration, the Pearson correlation analysis was conducted. The predictive value of perceived benefits, perceived barriers, and professional development to the attitude of the teachers was determined using the outcome of multiple regression analysis. The statistical significance was taken to be 0.05.

3.3. Ethical Considerations

In this study, the ethical approval was granted by the Ethics Committee of South China Normal University (Approval No. 1150588). All the participants gave informed consent, and data confidentiality was respected.

4. Results

4.1. Reliability and Descriptive Statistics

Internal consistency reliability was assessed using Cronbach's alpha. As shown in Table 1, the internal consistency of all constructs ranged from acceptable to strong. Attitude towards AI-enhanced technology integration had good reliability ($\alpha = 0.857$), as well as the perceived benefits ($\alpha = 0.876$) and perceived barriers ($\alpha = 0.838$). Professional development had a good level of reliability ($\alpha = 0.747$). Descriptive statistics showed that the scale of attitudes toward the implementation of AI-enhanced technology among the teachers was moderately positive ($M = 3.09$, $SD = 0.65$). Perceived benefits received the highest mean ($M = 3.24$, $SD = 0.71$), followed by the professional development ($M = 3.16$, $SD = 0.65$) and perceived barriers ($M = 3.15$, $SD = 0.72$). Overall, the answers were clustered towards the center of the scale, which suggests a moderate level of support for AI-related instructional practices and recognizes the current problems.

Table 1: Descriptive Statistics and Internal Consistency.

Variable	Mean	SD	Cronbach's α
Attitude	3.09	0.65	0.857
Perceived Benefits	3.24	0.71	0.876
Perceived Barriers	3.15	0.72	0.838
Professional Development	3.16	0.65	0.747

4.2. Correlation Analysis

The correlation analysis was carried out with the Pearson correlation test to investigate the connection between the four constructs. Attitude was positively correlated with perceived benefits ($r = 0.234$, $p < 0.001$) and perceived barriers ($r = 0.171$, $p = 0.010$) and professional development ($r = 0.160$, $p = 0.017$). These results show that teachers who were more likely to think that there would be more benefits of instruction or those who stated that they were more involved in professional development are more likely to demonstrate a more positive attitude towards AI-enhanced integration. There was a medium level of correlation between perceived barriers and professional development ($r = 0.470$, $p < 0.001$), with the mean difference indicating that teachers with greater perceived barriers had greater levels of professional development engagement. All positive and significant correlations with moderate to small effect sizes were present.

4.3. Multiple Regression Analysis

The predictive capability of perceived benefit, perceived barriers, and perceived professional development on attitude towards AI-enhanced technology integration among teachers was investigated using a multiple regression analysis. As shown in Table 2, the overall model was statistically significant, $F(3, 219) = 5.51$, $p = 0.001$, with $R^2 = 0.070$ representing the fact that the three predictors explained about 7% of the variance in teachers' attitudes. One of the predictors that was a large positive predictor of attitude is perceived benefits ($B = 0.175$, $SE = 0.064$, $t = 2.75$, $p = 0.006$). The standardized coefficient ($\beta = 0.192$) is a small-moderate effect size. Similarly, the perceived barriers were insignificant predictors of attitude ($B = 0.083$, $SE = 0.065$, $t = 1.28$, $p = 0.200$), and professional development ($B = 0.045$, $SE = 0.062$, $t = 0.73$, $p = 0.463$).

The results demonstrate that the perceived instructional benefit recognition of teachers is the most important factor in the formation of a positive attitude toward the use of AI-enhanced technology integration, but the perceived barriers to AI-enhanced technology integration and professional development experience do not have independent predictive value in comparison with the attitude when other factors are held constant.

Table 2: Multiple Regression Predicting Attitude.

Predictor	B	SE	β	t	p
Perceived Benefits	0.175	0.064	0.192	2.75	0.006
Perceived Barriers	0.083	0.065	0.089	1.28	0.200
Professional Development	0.045	0.062	0.048	0.73	0.463

Model fit: $R^2 = 0.070$, $F(3,219) = 5.51$, $p = 0.001$

4.4. Hypothesis Testing Summary

The results of the regression showed that the H1 was accepted: the perceived benefits significantly affect the attitudes of the teachers towards the implementation of the AI-enhanced technology. But H3 and H2 were rejected, the perceived barriers and the professional development were independent predictors without an important influence in the multivariate model.

5. Discussion

The paper has considered the perspectives of the teachers regarding the integration of AI-enhanced technologies in the teaching process in a vocal music course within the context of higher education in Guangdong, and also clarified the functions of perceived benefits, perceived barriers, and the experience of professional development. The conclusions add to the current debates on the adoption of technology in music education by extrapolating the old literature on the new AI-enhanced environment.

First of all, only perceived benefits could make the predictions about the attitudes of the teachers. The mentioned observation can be connected with the previous studies that underline the paramount role of the perceived instructional value in technology acceptance^[13]. The role of the Chinese teachers has been established, therefore, being more associated with teaching performance, rather than being useful, which is why the perceived usefulness has been perceived as a more important factor than technical convenience in the shaping of the attitude towards learning technologies^[13]. The current results prove this point: when the products that are enhanced with the AI are identified as the pedagogically important tool, i.e., the features of individual feedback and practice extension, it seems to be the determining factor in the

formation of the positive attitudes. The latter is also echoed in the former study about digital music technologies that has shown that digital audio workstations and interactive platforms can be effectively utilized in terms of engagement, creativity, and conceptual understanding used in learning contexts ^[20] ^[23] ^[24]. Nevertheless, it has been indicated that when technologic resources access are isolated, they are most likely to lead to superficial integration with little or no pedagogical change ^[11]. As the presented work states, the existing AI-based augmentation can also be less technologically sophisticated and may be less prone to the perception that teachers will see the actual benefits of their practice area.

Second, the perceived barriers did not independently affect the attitudes of the teachers, despite the high level of correlation between the two on the bivariate level. It makes this finding more complicated since continuation of previous issues in which inadequacy of time, institutional and technological experience can be the direct determinant of the negative orientations to innovation ^[9] ^[37]. Although it is a fact that the implementation is largely based on the structural limitations, the findings suggest that the educators can be capable of isolating the operational issues and the overall implications of the pedagogical potential of AI. According to Ertmer and Ottenbreit-Leftwich (2010), the relations between attitudinal change and instructional transformation are not always interdependent; in spite of the fact that the structural conditions are not ideal, the teachers can still see the perspectives of innovation ^[14].

Third, the attitudes of the teachers were not really sensitive to the professional development in the regression model. The result is that the studies have extended the previous studies that have proposed that teacher training and professional support are significant in technology integration ^[10] ^[36]. Although there were positive relationships between attitudes and professional development, the predictive value of professional development was lost to perceived benefits that indicated that training cannot be practiced to achieve a change in attitudes unless it is proven to be high degree of pedagogical meaning. Such support is provided by the fact that, unlike the independent acquisition of skills, technological competence is expected to be included in pedagogical content knowledge ^[10] ^[36].

Their synthesis enables saying that the role of the pedagogical meaning-making in the integration of AI in the field of vocal music education cannot be underestimated. Compared to the previous digital channels that were not so much connected with the improved accessibility or the possibility to produce something creative ^[7] ^[8], the AI-enhanced channels imply the intelligent feedback and the adaptive learning features that are simply opposed to the embodied and performance-based nature of the vocal pedagogy. Nevertheless, the adoption of AI seems to be reliant on the implication of the relevance of the technology to teaching made by the teachers respectively, but not on the novelty of the technology, according to the aforementioned findings that the technology is more apt to induce but not to transform the traditional teaching modes ^[4] ^[11].

On a higher cultural level, the results can be compared with the results that the standards of the community and the performance of the teaching were the origin of the technological judgments among the Chinese teachers ^[12] ^[13]. The perceptions of teachers regarding the digital transformation are moderate but positive in a more policy-oriented environment, where digital transformation of higher education is becoming a more and more popularized initiative ^[42], as long as the pedagogical worth of the innovation is apparent. Simultaneously, the fact that the reportedly low explained variance ($R^2 = 0.070$) may imply that there are other factors, including the disciplinary identity, self-efficacy, or institutional culture, that may have influenced further development of the attitude to the AI-enhanced technology integration, and that may be the focus of further study. The work adds to the theoretical insight into the technology adoption in the educational sector by altering the very notion of the AI incorporation as the phenomenon mediated by the pedagogical factor as opposed to the technological/institutional factor. The results show that the perceived importance of discipline-specific instructional value among the teaching staff outweighs the structural barriers and professional education in the development of such attitudes towards the application of AI-enhanced tools. It is a challenge to the existing conceptualizations of technology acceptance, which focus on usability and access and, rather, anticipate the pedagogical sensemaking as a significant technology acceptance mechanism, especially in performance-based and embodied learning.

On the whole, the provided work is a contribution to the available body of literature regarding the role of technology in the educational process in music, as it unveils that under the conditions of AI enhancement, the attitude of the teacher is largely defined by the perceived benefits of the pedagogical process, but not the structural limitations and exposure to professional growth. The above findings suggest the need to ensure that the AI technology progression is accompanied by the concepts of the discipline-related teaching practice to facilitate the long-term shift in the vocal music teaching in the environment of higher learning.

6. Conclusion

The present paper addresses the topic of teacher attitudes towards the integration of AI-supported technology into the vocal music instruction at higher education in Guangdong. The findings suggest that the teachers describe the overall positivity, and the most significant predictor is the perceived benefits of instruction. Teachers, however, with the help of structural impediments, find the usefulness of AI tools in enhancing vocal pedagogy. Professional development did not predict attitudes significantly when they regarded perceived benefits.

These results reveal that AI technologies must be capable of meeting specific teaching process approaches, and this is especially true in performance-based disciplines like teaching vocal music. Future research on more variables influencing technology adoption and longitudinal changes can be conducted as AI tools in education continue to advance.

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